Link, Dietmar; Baumgarten, Daniel; Klee, Sascha:

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Dynamic retinal vessel analysis using a spatial light modulator for stimulation

Dietmar Link; Daniel Baumgarten; Sascha Klee

— Author Affiliations & Notes

Dietmar Link
Biomedical Engineering & Informatics, Technische Universitaet Ilmenau, Ilmenau, Germany

Daniel Baumgarten
Biomedical Engineering & Informatics, Technische Universitaet Ilmenau, Ilmenau, Germany

Sascha Klee
Biomedical Engineering & Informatics, Technische Universitaet Ilmenau, Ilmenau, Germany

Footnotes

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Abstract

Purpose : Dynamic vessel analysis (DVA) with the Retinal Vessel Analyzer (Imedos Systems UG) is the Gold standard to measure alterations in retinal vessel diameter in health and disease. The DVA guidelines provide flicker stimulation of 12.5 Hz in a 30° field of view [1] (fixed full-field). However, to investigate local effects in the regulation of

retinal perfusion, e.g. neuro vascular coupling, spatially varying stimuli are required. We introduce and validate a spatial light modulator (SLM) based setup for DVA providing arbitrary stimuli in location and size.

Methods : We studied 15 volunteers (8m, 7f, 24.7±1.1 yr) to investigate the repeatability of the novel setup and to compare the new setup with the Gold standard. The relative vaso-dilatation value was determined for both. We measured four primary vessels: one superior temporal artery and vein (STa/STv), one inferior temporal artery and vein (ITa/ITv). All subjects were free of ocular and systemic diseases. A high-power LED (515 nm) and a transmissive liquid crystal SLM were connected to a mydriatic fundus camera. The field of view was set to 30°. The SLM was controlled via standard graphics card and a customized software (60 Hz refresh rate / 15 Hz flicker frequency). Each volunteer was measured three times. One measurement with the Gold standard and two with the new setup, in a random order (10 min pause time). Repeatability and comparison of the two setups were analyzed using the Bland-Altmann method. To value the differences among the group means we performed the t-test. For groups that did not meet the normality assumption we employed the Mann-Whitney U test.

Results : The repeatability analysis showed the following mean differences (MD), Limits of Agreement (LoA), both in %, and p-values. STa: MD=-0.78, LoA=-4.35/+2.79, p=0.134. ITa: MD=-0.67, LoA=-3.82/+2.48, p=0.131. STv: MD=-0.69, LoA=-4.30/+2.92, p=0.186. ITv: MD=-0.03, LoA=-3.00/+2.94, p=0.947. Comparing the two different setups the p-values were 0.545 (STa), 0.405 (ITa), 0.05 (STv), and 0.137 (ITv).

Conclusions : We realized a working experimental setup and applied a new approach of Dynamic Vessel Analysis using a spatial light modulator. Validation was realized in comparison to the Gold standard.

The agreement between the two different setups was predominantly good. Neither the repeatability analysis nor the comparison of the two setups showed significant differences.

This is an abstract that was submitted for the 2017 ARVO Annual Meeting, held in Baltimore, MD, May 7-11, 2017.